Report on Earthquake Sikkim Nepal Border-2011

1. The Incident followed by Geological information:

Date of occurrence: 18/09/2011
Time: 18:11 hrs (IST)
Magnitude: 6.8
Focal depth: 10 Km
Epiecentre
Latitude & Longitude : 27.7$_{o}$ N & 88.2 $_{o}$ E
Region: Sikkim-Nepal Border region.[1]

2. History of Earthquakes and Seismic Vulnerability of the Region:

Historical and instrumentally recorded data on earthquakes show that the Sikkim and adjoining area lies in a region prone to be affected by moderate to great earthquakes in the past. Some noteworthy earthquakes that have affected the region are:
(i) Cachar earthquake of 10.01.1869 (M: 7.5),
(ii) Shillong plateau earthquake of 12.06.1897 (M: 8.7),
(iii) Dhubri earthquake of 02.07.1930 (M: 7.1),
(iv) Bihar-Nepal Border earthquake of 15.01.1934 (M: 8.3),
(v) Arunachal Pradesh – China Border earthquake of 15.08.1950 (M: 8.5),
(vi) Nepal-India Border earthquake of 21.08.1988 (M: 6.4)
(vii) Sikkim earthquake of 14.02.2006 (M: 5.7)
(viii) Bhutan earthquake of 21.09.2009 (M: 6.2)

The Sikkim and adjoining region is known to be part of the seismically active region of the „Alpide-Himalayan global seismic belt", with four great earthquakes of the world of magnitude 8.0 and above occurring in this region. The occurrence of earthquakes in the region is broadly associated with the tectonic activity along well known faults in the Himalayas, namely, Main Boundary Thrust (MBT), Main Central Thrust (MCT). Other prominent geological / tectonic features in and around Sikkim include: Tista lineament, Kunchenjunga lineament, Purnea-Everest lineament, Arun lineament and Dhubri fault in the southeast.
In the seismic zoning map of India prepared under the auspices of Bureau of Indian Standards (BIS code IS: 1893: Part I 2002), by a committee of experts representing various scientific institutions including India Meteorological Department (IMD), the **entire area of Sikkim lies in Zone IV**. The seismic **Zone IV** is broadly associated with **seismic intensity VIII** on the Modified Mercalli Intensity (MMI) scale. It may be mentioned that the seismic intensity VIII on MMI scale corresponds to a horizontal ground acceleration range of 51-350 cm / sec$_2$ or an average acceleration of 172 cm / sec$_2$ in any direction. The ground acceleration and hence the intensity of an earthquake at a place depends on magnitude of earthquake, distance from the focus, duration of earthquake, type of underlying soil and its damping characteristics and liquefaction potential. The damage to the buildings founded on soft soil or filled up earth is higher than that in the similar type of buildings having their foundation on hard bedrock. Also, the damage will be higher for higher magnitude and

[1] IMD report

long duration earthquakes, less epicentral distance soft soil conditions and areas with high liquefaction potential.

The Sikkim, India Earthquake has occurred near the boundary between the India and Eurasia plates, I the mountainous region of northeast India near the Nepalese border. Initial anlyses suggest the earthquake was complex, likely a result of two events occurring close together in time in depths of approximately 20 K.m beneath the Earth's surface. At the latitude of the September 18 earthquake, the India plate converges with Eurasia at a rate of 46 m.m/yr towards the north-northeast. The broad convergence of two plates has resulted in the uplift of the Himalayas, the world's tallest mountain range. The preliminary focal mechanism of the earthquake suggests strike slip faulting, and thus an intraplate source within the upper Eurasian plate or the underlying India plate, rather than occurring on the thrust interface plate boundary between the two.

The region has experienced relatively moderate seismicity in the past, with 18 earthquakes of M5 or greater over the past 35 years within 100 km of the epicentre of the September 18 event. The largest of these was a M6.1 earthquake in November of 1980, 75 Km to the southeast.

Seismic Vulnerability: seismic zone map of West Bengal shows that Coochbehar and Jalpaiguri districts of West Bengal fall in zone V meaning that there is probability of experiencing large earthquakes and huge damages due to large earthquakes. From Malda to Darjeeling and North and South 24 Parganas fall in zone IV. But West Bengal has become epicentre for no significant earthquakes of India.

During 1737 to 1993 Kolkata and adjacent areas experienced 67 earthquakes. Kolkata and Contai earthquakes of 1897 and 1964 were moderate earthquakes having intensities of 5.0 and 5.5 of Richter scale. But Kolkata experienced huge damages of infrastructures.

Kolkata also faced huge damages as consequences of earthquakes occurred in Shillong plateau in 1897 at Bihar –Nepal border in 1934.

North east India falls in seismic zone V. What is the reason of that? Collision zone of Indian plate is situated in the north of the region and the subduction border of Indian plate is situated in east of the region. Moreover the whole is region is divided into various tectonic blocks. Due to immense pressure of collision and subduction of those blocks are not static . Many active faults are also in force.

Shaking, subduction, , rising or cracks along fault, liquefaction, tsunami, seiches, flooding due to dam failure, fire are major hazards due to earthquake.

Numbers of casualties, degree of loss of property depends on the intensity of the earthquake, structural types and quality of the construction of the inhabited area, time of earthquake, soil type etc.

3. Glimpses of Damages as seen through Field Visit:

Some areas in Mal and Sadar subdivisions of Jalpaiguri district and Siliguri sub-division of Darjeeling district have been covered during the field visit.

Damages to the private buildings: Visited few tea estates, where cracks have been developed in the labourerer's and staff quarters.

Nedam Tea Estate is a Gram Sansad of Rangamati Gram Panchayat of Mal Block. The only casualty occurred because of the said earthquake is in this tea garden.

Ranjit Nagesia alias Anjit son of Jugani Nagesia about 18 years of age died due to wall collapse during the earthquake. He was returning to his home during the earthquake. The said wall was damp and cracked at several places.

Cracks have been developed in several houses in the labourer quarters. Some of the houses had vertical as well as horizontal cracks in the walls as shown in the pictures below.

In two houses cracks have been occurred in the floor.

In Matiali tea garden under Matiali block at Samsing cracks have been developed in many houses. One wall of each of the two houses was collapsed during the incident.

There are few cases of fire after earthquake reported in Chalsa area in Matiali block. But the houses could not be visited.

In the urban areas of Jalpaiguri, Siliguri there are reports of cracks in the residential buildings. But two cases of partial subsidence of multi-storied buildings have been noticed. In each cases one building is seen leaning against the adjacent building.

Samajpara, Jalpaiguri Town

A case of landslide could be noticed in Nedam Tea Estate, Mal.

Some cases of fire after earthquake have been heard in Chalsa under Matiali Development Block.

Government buildings: Several cracks have been observed in the **office of The SDO Mal**. The building is owned by Jalpaiguri Zilla Parishad.

A newly constructed large hall adjacent to the office chamber of BDO, in the **office of the B.D.O, Matiali** has developed cracks in each of the four walls.


The Collectorate building of Jalpaiguri district developed a number of cracks in different positions.

Some of the cracks are shown in following pictures,


Health Services: Among the public utility buildings health centres have been damaged to a large extent. Mangalbari BPHC in Matiali block was visited on 21st September, 2011. A number of cracks have been found in the rooms where the patients are being kept after admission. The residential quarters of nursing staff have also been damaged badly.


Inside Mangalbari BPHC


The structural condition of the BPHC where the indoor patients are kept is so vulnerable that the Doctors are scared to admit patients and are also in a dilemma how long they would be able to continue the medical treatment.

Jalpaiguri District Hospital was visited on 22nd September, 2011. Several cracks of various types have been noticed in a new building. Some of the cracks can be seen in the following pictures. It is heard that the old buildings are not damaged.

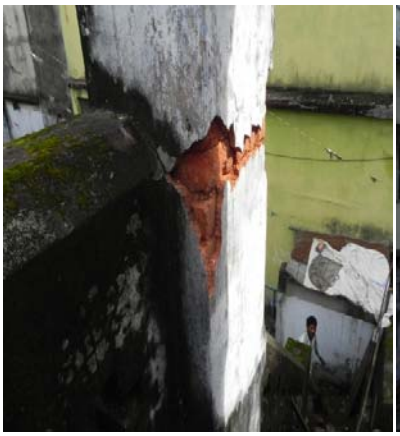

Educational Institutions: Matiali Junior High School for Girls' is one of the hardest hit buildings by earthquake in Mal subdivision.

Matiali Junior High School for Girls

In Siliguri town, the library building of Siliguri College is also very badly damaged. The building was inaugurated in the year 2000. As expressed by Prof. M Karanjai, Principal of the College, damages did not occur in older buildings.



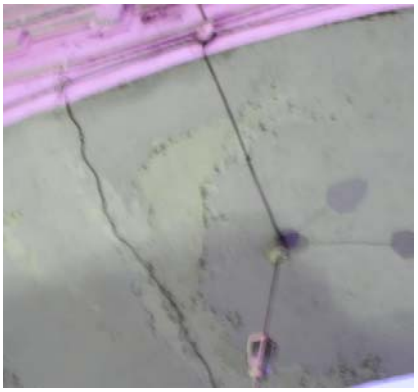

Religious Places: Dinbazar Chota Masjid in Jalpaiguri town was severely damaged by earthquake. Pillars from different sides, portions of the minarets as well as boundary walls were badly damaged and are in precarious condition. If broken, those debris would hurt the people on the road.



The topmost dome of a Shiva temple at ward no-20 in Siliguri town was broken down and caused destruction of roof of the adjacent house.


Damage to the archaeological structures: 'Singha duar'can is regarded as gateway to the Jalpaiguri town. The structure was damaged very badly in each side as a result of shaking on 18th Sept.





Public Health related issues: Number of patients came to various health centres including nearest BPHCs. Talked to the staff of Mangalbari BPHC and Siliguri District Hospital. As observed there are rare cases of physical injuries as reported to the hospitals after the shaking. Majority of patients admitted were suffering from trauma related problems consequent of shaking.

Non-structural Issues: Casualties and injuries would have been more had the earthquake occurred during day time in office day or in the night time. Casualties and injuries increase not only because of the structural failure of the buildings but because of the habit of the people to keep things in unsafe manner. Architectural designs also can increase vulnerability of a structure for example, materials used for flooring, walling, false ceiling etc.

It has been heard that in many of the houses things including pictures hanging in the wall fell down and some of those were broken. Furniture like refrigerator was toppled. These could have injured people.

One case of injury is reported in Matiali block, where Subrata Kerketta, two years old boy was severely injured when a burning kerosene lamp fell on him during shaking. At the time of visit the child was undergoing treatment at Mal Sub-divisional hospital. This is a case of injury due to non-structural reason.

It was reported from many offices including the hospitals that things kept above the almirahs fell down on the floors. In addition to that the no furniture is fixed to the walls. The pictures below would better illustrate the point. So, result of shaking would have been more number of casualties had it occurred during office hours.



People would not be safe even if they leave their buildings during such incident as there is no open space in congested areas where people can safely stand.

Lack of information/knowledge: It was shared by many irrespective of their rank that they did not know what to do during shaking, which was safe which was not. One person reported to have died while escaping from one building.

Communication: the district administration mentioned that the cellular phone service was totally disrupted after the incident because some the towers got damaged. But fortunately landlines were working. But due to our present day tendency, the landline numbers are not in regular use and the numbers of important officials were not readily available (only the mobile telephone numbers were available). That hampered the process of post-disaster assessment since it took sometimes to collect the landline numbers.

4. Observations for earthquake disaster risk reduction:

There is a saying 'Earthquake does not kill people but weak structures do'.

There are two sides of disaster management; first is disaster risk reduction and second is preparedness towards emergency risk management:

First let us discuss 'Earthquake Risk Reduction'- Long term measures

1) Each block and each municipal body should do 'Risk Analysis' and 'Vulnerability analysis' Gram Sansad wise and ward wise respectively.
2) Each department working in such areas are to be involved during such exercise so that
3) Municipalities, Corporations for the urban area should be aware of such hazard in their area, accordingly they have to prepare a proper land use map as well as land use plan especially for newly built up area.
4) At present each municipality and corporation should make an assessment of the situation and prepare an action plan for seismic safety for their citizens. CAPSS (community action plan for seismic safety) as done in San Francisco, USA may be consulted for guidance where three main tasks like; Loss Estimation, Repair Standards and Planning were included.

a) Keeping free space between the adjacent buildings should be made mandatory while constructing buildings.
b) Soil testing should be made compulsory while constructing multi storied buildings,
c) Building code, if exists should be strictly adhered to, if not, building code is to be framed,
d) Each civic body responsible for sanction plan should have engineers trained in seismic control.
e) Masons may be trained in constructing seismic resistant constructions, whom people can hire for constructing their houses.
f) ULBs may think of giving some incentive in taxes for building houses or retrofitting houses with disaster mitigation measures

5) Public utility buildings need to be constructed under the strict guidance and control of trained person,
6) Construction plans for school buildings and hospitals are to be made keeping in view of the vulnerability analysis of the area.
7) Awareness building exercises should be taken throughout the year with common masses on structural and non-structural mitigation measures.
8) It should be mandatory for managing committee/ Parent Teacher Association to take structural and non- structural mitigation measures in their schools

5. Emergency preparedness:

1) Hospitals and medical health centres are to be better equipped for emergency treatment in respect of both infrastructural as well as in human resources.
2) Psycho social care is needed in post disaster management. Psycho emotional care or trauma management system is not prevalent in our society. But experiences of large disaster incidences like Bhuj Earthquake, Tsunami etc. show the need of psycho social care and trauma management. The women SHGs may be trained to give psycho social care at primary level. Psychiatrists may be made available at district hospitals to treat for patients for critical trauma care.
3) Emergency plans should be in place for each public utility buildings with proper display for users. Drills can be conducted in regular basis.

4) Emergency communication contact numbers should be displayed in public buildings in prominent places.
5) School children needs to be educated on do's and don'ts' during earthquake. Drills for practice are to be conducted in regular manner.
6) Local clubs, NGOs can be trained in emergency preparedness.
7) Communication facilities are needed urgently just after the incidence, so there should be emergency communication plan. Use of HAM radios should be promoted and Higher Secondary Schools having science section should be assisted to start HAM Radio club. Besides, the HAM radio operators of the area are to be enlisted and contacted when needed.

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